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**A Qualitative Research Approach to Understanding Challenges that may
Inhibit Optimal Usage of Automatic Milking Systems in Northern Utah**

by

Jessica Christensen

**Capstone submitted in partial fulfillment of
the requirements for graduation with**

UNIVERSITY HONORS

with a major in

**Animal and Dairy Science
in the Department of Animal, Dairy, and Veterinary Science**

Approved:

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Abstract

Dairy robotics, i.e., Automatic Milking Systems (AMS), is a relatively new field, one that has great promise to optimize efficiency, production, and animal welfare of dairy cattle. However, despite quantitative research findings that indicate AMS success, dairy farmers still face challenges integrating AMS into their production systems. During the fall of 2018, interviews were conducted with northern Utah dairy farmers regarding their robotic systems. The respondent data was analyzed to reveal repeated problems with the robots. This analysis was then used to direct research in order to propose solutions to the farmers' AMS challenges. Conclusions were then summarized in an Extension publication designed to help USU Extension agents understand issues and opportunities with AMS technology from a user perspective and, thus, effectively assist farmers with AMS challenges.

*For my family,
who believed in me and
laughed at my experiences
“from behind.”*

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Honors Capstone

Introduction

In 1944, the United States' dairy cow population was estimated to be twenty-five million (Jacobs, *et al.*, 2012). The average dairy cow only produced around 5,300 pounds of milk per year in 1953, lending to the need for a large dairy cow population to fulfill the demand for dairy products (Jacobs, *et al.*, 2012). However, since that time, the dairy cow population has decreased from twenty-five million cows to nine million cows, with an average yearly milk production of around 19,950 pounds in 2007 (Jacobs, *et al.*, 2012). This decrease in population in connection with an increase in milk production can be credited to advancements in "genetics, milking machines, nutrition, and farm management" (Jacobs, *et al.*, 2012), as well as "improvements in nutrition and management" (Barkema, *et al.*, 2015). Even simple changes, such as using sand for bedding instead of wood shavings, can be considered advancements within the dairy industry.

Since the 1970's, technological advances have been on the forefront of agricultural developments (de Koning, 2005). Advancements include "pedometers or activity monitors for estrus detection, in-line sensors to determine milk quality, composition and electrical conductivity characteristics of milk...and the use of sexed semen" (Barkema, *et al.*, 2015). Another development that occurred in the 1980's in the Netherlands was an automatic milking systems (AMS) or robotic milker (Castro, *et al.*, 2012). In 1992, the first automatic milking system was installed by the LELY company in a dairy in the Netherlands (Schewe, *et al.*, 2014; Castro, *et al.*, 2012), and in 1999 the first AMS was installed in North America in Ontario,

Canada (Barkema, *et al.*, 2015). Currently, ninety percent of all AMS systems are installed in dairies in Northern Europe, specifically the Netherlands, Germany, and Denmark (Schewe, *et al.*, 2014). The remaining ten percent of AMS is split between Canada with nine percent and the United States with only one percent of all automatic milking systems, most of which are in the Eastern U.S. and the Midwest (Jacobs, *et al.*, 2012). Possible explanations for this lack of automatic milking systems in the U.S. could be skepticism about the new technology, a lack of suppliers for AMS, and the smaller size of dairy herds in Europe compared to herd sizes in the U.S. (Jacobs, *et al.*, 2012).

Despite the variance of AMS locations and the various companies supplying robotic milkers—LELY, GEA, DeLaval—the function of all the robotic milkers is essentially the same: the robots promote voluntary milking on the cows' part; she decides her schedule of when she will be milked based on her "good will to voluntarily be milked" (Drach, *et al.*, 2017). Automatic milking systems have six main components: "the milking stall, [the] teat detection system, [the] robotic arm that attaches the cups to the teats, [the] teat cleaning system, [the] electronic monitoring system, and [the] milking machine" (Holloway, *et al.*, 2013). In addition, an incentive in the form of a "highly palatable concentrate" is dispensed in the robot's feeder as the cow is being milked (Jacobs, *et al.*, 2012). But, as Jacobs and his colleagues state, if the transition to AMS or her environment is stressful, the dispensed feed might not be enough of an incentive for her (2012). In this regard, the set-up of the robotic milkers as well as management style largely dictates the success of implementation and future success of a farm's automatic milking system.

Motivation for farmers to install automatic milking systems include rising costs of labor, unavailability of labor, desire to increase milk production, desire for increased leisure time, and

to increase cow health (Hansen, 2015; Christensen, 2018). However, farmers' expectations and attitudes about goals, the process of implementation, and use of the robot and robot software largely dictate how successful the automatic milking system will be (De Boyer des Roches, *et al.*, 2016). De Koning writes that key factors to implementing automatic milking systems into farm systems and management are "realistic expectations; good support by skilled consultant before, during and after implementation; flexibility and discipline to control the system and the cows; ability to work with computers; a well-adapted barn layout supporting a smooth cow traffic; good technical function of the [AMS] and regular maintenance; healthy cows with good feet and an eager eating behavior" (2005).

If an automatic milking system is implemented successfully, farm labor-hours can decrease by twenty percent to thirty percent, milk production can increase anywhere from six percent to thirty-five percent, and as a local dairy farmer expressed, his incidence of lameness has become almost inexistent (Schewe, *et al.*, 2014; Christensen, 2018). However, there are an abundance of conflicting studies regarding these results, as well as other production factors. For example, one study showed that within two weeks of AMS implementation, seventy-five percent of the herd was milking voluntarily (Jacobs, *et al.*, 2015). However, as USU's Caine Dairy, within the first two weeks, one hundred percent of the cows were milking voluntarily, resulting in little to no fetching of non-milking cows or an increase in current culling rates. Another example can be found in incidence of lameness. One study showed that incidence of lameness either stayed the same or increased for fifty-eight percent of participating dairymen (Tse, *et al.*, 2017), whereas a local dairyman reported that, as stated previously, his incidence of lameness has been all but eradicated since implementing an AMS (Christensen, 2018).

Despite some of these listed advantages to installing automatic milking systems, there are several significant drawbacks to the robotic milkers. First, farmers must dedicate significant time to training their cows to being milked by a robotic milker, taking anywhere from three days to three months (Jacobs, *et al.*, 2012; Christensen, 2018). Possible remedies could be exposing cows to mechanical sounds and motions as well as implementing a “training system” (Jacobs, *et al.*, 2012; Christensen, 2018). In addition, free cow traffic with ample space around the milker can be established instead of guided cow traffic systems (Rodenburg, 2017). Second, each robot collects well over one hundred variables with thousands of data per variable, at times overwhelming farmers with information (Christensen, 2018; Hansen, 2015). This is an issue that, although is universal, is unique to the “context...of technology and users” (Schewe, *et al.*, 2014). Some farmers have difficulty transitioning to the new technology from their old systems, and many either use both or only use the previous, familiar system (Christensen, 2018; Hansen, 2015). Third, the cost of a single robotic milker can range between \$150,000 to \$200,000 with possible additional costs to retrofit existing parlors or to create entirely new milking facilities, versus a new parlor that costs \$4,000 to \$15,000 per stall (Jacobs, *et al.*, 2012). In addition, the capacity of a single robotic milker is usually only forty to sixty cows, making it more expensive for medium and larger sized dairies—such as are found in the U.S., particularly in the west.

In the context of dairies located in the western U.S., diffusion of this technology has been slower to take hold among producers. As previously suggested, this could be due to distrust of new technology that to some point has yet to be proven (Barkema, *et al.*, 2015). Other hypothesized reasons include lower milk prices and labor costs as well as the significantly larger size of dairies in the western U.S. (Barkema, *et al.*, 2015; Christensen, 2018); medium sized dairies in Europe have fifty to one hundred cows, whereas small, family-owned dairies in the

western U.S. usually have around one hundred and eighty cows or more (Christensen, 2018).

However, despite these barriers to farmers in the western U.S. adopting automatic milking systems, there has been an increased interest in AMS implementation, specifically in northern Utah and southern Idaho.

Background Information

In 2015, one of the first automatic milking systems was installed in Cache Valley, located in Northern Utah (Christensen, 2018). Since then, at least three other farms in Cache Valley have installed automatic milking systems, in addition with several other farms in the surrounding area and southern Idaho installing AMS, too (Christensen, 2018). However, this rapid influx of new technology and management systems has not only required new skills from dairy farmers, but also from dairy consultants, such as county Extension agents (Eastwood, *et al.*, 2012). Although research has been conducted on automatic milking systems that have been implemented in Europe and Canada, relatively little data has been gathered about automatic milking systems in the U.S., particularly the western U.S. Thus, Extension agents, unless they have had first-hand exposure or training regarding automatic milking systems, have been struggling consulting with dairies that have automatic milking systems, particularly dairy farms that have recently installed AMS.

Although AMS companies—particularly LELY—and local dairy technology companies have farmer support systems in place that assist farmers with AMS implementation and maintenance, Extension agents have been left out of the loop, so to say, and have not been able to assist dairy farmers who have installed automatic milking systems.

Hypothesis, Methods, and Limitations

The purpose of this study was to discover if dairy farmers in northern Utah face challenges integrations automatic milking systems into their production systems.

Hypothesized problems or challenges included: first, the new, advanced, and computerized technology is unfamiliar and to dairy farmers; second, the amount of data received from robots in the form of reports is overwhelming to dairy farmers; third, there is a learning curve for the dairy farmers as they adjust to managing their cows with automatic milking systems; and fourth, there is potential for farmers to become apathetic towards their relationship with cows due to the robot's capabilities.

Interviews were conducted with farmers and consultants to gather data regarding their experience with AMS. The respondent data was analyzed to reveal repeated problems or challenges faced by dairy farmers with the robotic milkers. In addition, previous experience with dairy farmers and their robotic milkers was drawn upon for context of the results, as well as off-the-record comments from farmers and consultants. Once analysis was complete, it was used to direct research in order to propose solutions to the farmer's AMS challenges, particularly what practices Extension agents can use to assist farmers implement and utilize AMS on their farm. These conclusions of best practices for Extension agents were then summarized into a publication that USU Extension can distribute among their county agents to help them understand issues and opportunities with AMS technology from a user perspective.

Despite best practices conducted by the principal investigator, there were several limitations to the study. First, all the automatic milking systems located in Cache Valley are LELY Astronauts; only one GEA was known to be in use along the Wasatch Front. Based on

conducted literature review as well as an interview, LELY has been proven to be one of the best automatic milking systems. However, research would have been wider in scope had other AMS systems been available to study. Second, only two interviews were able to be conducted, one with a dairy company owner, and one with a dairy farmer. The principal investigator was not able to contact other farmers who would be interested or willing to participate. This could be due to lack of familiarity or use of technology, such as email, text, or voicemail. In addition, there is the threat of unknown security and biosecurity on dairies; due to extremist groups as well as foreign microbes, dairy farmers don't allow people on to their farms without permission. Trying to "cold-contact" dairy farmers, without previous introduction, can be difficult, and therefore resulted in few participants. However, the two participants proved to be knowledgeable about other dairies in the area, such as their levels of production, management systems, and struggles with AMS.

Results and Discussion

Based on the literature reviewed and interviews conducted, it was concluded that there are four predominant challenges faced by dairy farmers implementing AMS into their production systems:

1. Dairy famers are unfamiliar with computerized technology and smartphones. There is also an immense amount of data collected and presented by the robot, overwhelming the farmer.
2. Farmers are not spending as much time observing the cows, suggesting that there is a possible disconnect from the cows behind the numbers and reports.
3. Additional health devices, such as somatic cell devices and rumination collars, add more variables and data into the already overwhelming amout of information farmers receive from their robots.
4. Training all cows to adjust to being milked by a robotic milker has proved to be a time consuming and challenging process for the dairy farmer.

Academic research and review papers were then studied to in order to propose solutions to these challenges. Solutions to these issues are both for dairy farmers as well as Extension officers.

Computerized Technology and Smartphones

During an interview with a dairy farmer, he stated “if you will delve into [the software] and be determined to learn it, within two years you can be every bit as happy with it as you are with any other program out there” (Christensen, 2018). For this farmer, he kept his original

software, DHI-Plus, for the first year after installing robotic milkers. He said, “You’ve just got to take the time to get to know it. The first year, I never would have said that because I kept DHI-Plus because that’s what I knew. The fact is, I’m forty-five plus years old. At forty-five plus years old I don’t learn that stuff as I did when I was twenty-two and I learned DHI-Plus. And I think that’s the position that most of the people who are putting in robots—they’re not twenty-two years old” (Christensen, 2018). However, taking a year or two can cost a significant amount of milk production and cow health if the farmer doesn’t know how to read the reports or won’t read the reports because he’s unfamiliar with technology. As Hansen says, “conversion to milking robot[s] radically changes the work of the stockperson...this change requires a transformation of the whole management process” (2015).

Extension and Extension agents could help resolve this challenge—not just for farmers implementing automatic milking systems, but for farmers introducing other computerized technology—by holding training classes or seminars in their various counties, or multiple county areas. This would allow farmers to learn how computerized systems work and ask questions in a low-risk environment. In addition, it would allow Extension agents the opportunity to research AMS software in preparing these trainings. In these trainings, it is suggested that Extension agents train on how to sift through immense amounts of data to make informed management decisions, based off AMS software specifically. It is the hope that these types of trainings would give the opportunity to Extension agents to be proactive in learning about automatic milking systems while also provide an invaluable service to dairy farmers.

Cow Disconnect

As author Hansen writes from his study in Norway, “The farmers underline that the AMS can never take over the job for a good stockperson... ‘You have to monitor the cows carefully, be structured and follow up immediately whenever there’s a deviation...It’s so easy to put it off until tomorrow” (2015). A local dairy company owner told the story of a local dairy farmer and his family travelling to the other side of Utah to attend a child’s sport tournament (Christensen, 2018). On the other hand, though, a different dairy farmer struggles even leaving the valley, worried about being a few hours away from his farm if the robot “calls” in any problems (Christensen, 2018). In this case, switching to automatic milking systems does give you “more flexibility, but it’s freedom with responsibility” (Hansen, 2015).

As far as Extension intervention, there is not much that can be done by agents other than suggesting management changes when consulting with AMS using dairy farmers facing issues in their relationship with their cows. As Hansen suggests, “farmers [must behave] proactively and not just [adopt the robots], but also [adapt] the new technology to their specific needs...To succeed with AMS, farmers need to act proactively in following up the individual cows, and to get familiar with the herd management system. Thus some of the saved time must be spend on monitoring the cows and the AMS” (2015).

Additional Health Devices

While adding more data into the pool may seem daunting, somatic cell devices and rumination collars have helped farmers in management decisions, despite the increase in information. Somatic cell devices give more detailed information about the health of the udder of

a cow, down to the individual quarters. In some cases, it can even detect subclinical cases of mastitis and save farmers future vet visits (Christensen, 2018). A local dairy company owner shared a story about a farmer's experience with this: "We had one of the dairymen, soon after he put the system in, he walked along their feed fence and saw pieces of wire in the feed, and that's not a good thing for cows to eat. That's usually going to result in some dead cows. They thought, 'What in the world has happened? And then they realized, 'Oh, we just put this system in, we might want to check the rumination numbers.' Here were six cows in trouble on rumination—it dropped right down, they just weren't eating, they weren't chewing their cud. They went...and put magnets in these cows, which grabs the wire and holds it, so they can either get rid of it or it hold it, so it doesn't perforate the inside of the cow. The cows dropped way down on the feed, they got sick, but then they came back out of it. They didn't lose any cows—the information was there' (Christensen, 2018). Another dairy farmer testified that, "every morning we look at the activity monitors and we see the cows that are in heat, we breed them; they get pregnant" (Christensen, 2018); because of additional information provided by these devices, his conception rate has increased drastically. In addition, this extra information gives Extension agents more information regarding the health and production levels of a farm when consulting with dairymen. However, Extension agents must be literate in understanding the language of the AMS software in order to effectively consult using this information.

Cow Adjustment

There are two main philosophies regarding cow traffic in robotic milking setups, both influencing "labor efficiency and cow comfort" (Rodenburg, 2017). One is "free cow traffic" and the other is "forced cow traffic" or "guided cow traffic" (Christensen, 2018; Jacobs, *et al.*, 2012).

Free cow traffic “allows cows to freely move between feed alleys, lying stalls, and the AMS at any time they choose” (Jacobs, *et al.*, 2012), and guided cow traffic uses “a series of one-way gates, and if the cow wants to get to the feed fence or back to her bed, the only way to get there is to be forced through the robot” (Christensen, 2018). Guided cow traffic has been shown to increase the amount of milkings, but it decreases time spent feeding and results in less resting time (Rodenburg, 2017); guided cow traffic shows an increase in stress, which has been linked to lower production levels. With free cow traffic, “cows break quicker, they train to the robots quicker, and we get better results, and we get them faster...And to back that up, it was the Journal of Dairy Science [who] did a pretty extensive three-year study on that and found that guided cow traffic, or forced cow traffic, versus free cow traffic—I think it was [a] 2.4 pounds of milk per cow per day [difference] on average”, favoring free cow traffic (Christensen, 2018).

For Extension agents, when dairy farmers are first installing robots, agents can suggest building plans favoring free cow traffic. In addition, for farmers who already have established AMS, Extension agents can either suggest removing forced cow traffic gates, or improving the flow of free cow traffic, such as providing more space around the robot so the cow inside the robot doesn’t become scared or blocked in by other cows by the exit (Rodenburg, 2017).

Conclusion

Based on preliminary research from literature reviews as well as personal interviews, automatic milking systems have increased production, efficiency, and cow health; however, dairy farmers still face challenges optimizing their systems, and Extension agents lack adequate information or training regarding automatic milking systems to adequately assist dairy farmers. Extension agents can play critical roles in assisting dairy farmers adjust to new management styles and operation systems. However, if Extension agents are to do this effectively, they should have their own strategies in place to assist farmers with AMS, as well as develop an understanding of the management and operations required with AMS dairies.

A publication from this project will help Extension agents understand issues and opportunities with AMS technology from a user perspective, and, thus, effectively assist farmers.

Areas for continued research include studying differences between various AMS installed in northern Utah, such as the GEA and LELY systems. Other research projects on the production levels of automatic milking systems in northern Utah specifically would be a valuable resource to other farmers in northern Utah as well as the western United States, instead of relying on studies done in the eastern U.S., Canada, Europe, Israel, or Australia, where production levels and management styles are vastly different.

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Interview Transcriptions

Dairy Company Owner Interview

Interviewer: Jessica Christensen

Interviewee: Dairy Company Owner

Interview Setting: Dairy farm located in Southern Idaho

Affiliation with interviewee: Has been contact for information about LELY products

(Start of Interview)

***Interviewer:** There's just a few things here, just a little bit of introductory information. So just kind of tell me, if you would, how you kind of got started in the dairy industry, started with LELY—just a brief history of your involvement with LELY.*

Interviewee: Well we started the dairy equipment business—I started working in dairies and the equipment part, not milking cows, I did that as a kid, but we started putting equipment in dairies, I did at least, in 1974. So, I've been doing it a long time. We've had a dairy equipment business in two places in Idaho and one place in Utah for a lot of years. [Inaudible] came to the point on robots—I watched them at different shows and things for years and made fun of them actually—thinking they [couldn't really work] and didn't ever seem to work really well, but we kept watching them. At a certain point, I made the statement, "I'm not going to be the guinea pig on robots. When we get a company that can boast they have thousands of them out there running, milking cows, and that they've actually gone through another generation to where they've

simplified it and the price tag's come down," I [said], "Then [is] when I'll get involved with robotics and milking cows." And that day came, and we went, like anybody else, shopping for robots—which one I wanted to represent. So, we looked at the different robots, and I finally decided the guys who were ahead of the game were the LELY robot. I wasn't a dealer then, that was just my own research. And my final part of that research, was I loaded up some of the dairymen that we're friends with and I've known for years, some feed guys, and we got on a plane and we flew to Michigan, we rented a car, and we drove around some different dairies and talked to the dairymen that were using them, including the University of Michigan there, and looked at their robots, watched them, and interviewed them. And by the time that trip was over, I was convinced that it was time to get involved with robots, and that LELY robot was the one that I was most interested in. We did, it was soon after that, that we signed on as a dealer for LELY. Of course, LELY requires us to get a certain amount of training in before we can install robots or service them. We have to pass all those different courses, which we've done. So, I guess that was back in [2013] or [2014], and we got some robots sold, [and] it was the next year before they were up and running. So, we've had, I think, our first installations are over three years old now, three and a half years that they've been running now, actually milking cows that long, and we just keep adding to the numbers.

Interviewer: When you went up to Michigan, and you were interviewing these farmers, do you recall what some of those things the farmers said that convinced you—does that make sense? Just some of those points as you were researching LELY, as you went and actually saw it, what were some of the selling points for you? Does that make sense?

Interviewee: It does. Some of the selling points I wanted to know, and what they were telling me: every one of them had increased their milk production. Of course, they had their cows

already, so the same people, same cows, same feed, [same] genetics, [inaudible] when they had gone to the robotic milkers it had increased milk production. It increased cow health. And it changed their lifestyle because they didn't have to have this big army out there milking the cows anymore. One of the other things—a selling point that I had dairymen point out to me more than my own eyes—is when you went out in among the cows, walking through the corrals—which we did—the cows didn't scatter away from you, they would stand right there [and you could] pet them. And they're right up there sniffing you. And the dairymen were saying, "These are the friendliest cows I've ever seen." They're not being chased anymore. When you're out there in the pen, you're not there to chase them somewhere to be milked. [The cows are] just looking, "What are you doing here?" They're not being chased, so yeah, they change totally. So, I saw the benefits for the cow, the dairymen. And then of course I asked, because I have to fix them, how much trouble they had with service and repairs. They didn't seem to be out of line. They were all happy, all of them said they'd do it again and were enthused about what they had done. I didn't find any guys with regrets on that trip. So, I thought, "Yeah, this is going to be the future." And I was convinced that is the future of dairy. I look at the labor, I know what guys go through because they complain to me on their dairies, and I know they'll struggle with that, and [inaudible] dairy is going to adopt that, but in my own mind I thought, "When had automation not won out in this world?" It does need to be to a certain level of proficiency and without problems and service issues, but it has always won out, and there's no difference here. This is going to be the future of the dairy industry, is robotics, because labor is an issue. And it's a way of increasing their efficiency—it lowers their cost to produce one hundred pounds of milk. And that's what automation is all about.

Interviewer: So, it's increased production, it's increased cost efficiency, it's increased cow health and just cow demeanor even.

Interviewee: It does.

Interviewer: Have you seen that evidence even here within the valley in the past three years you've been installing these robots? Have you seen what these dairy farmers up in Michigan were testifying of?

Interviewee: Yes, we have. I think—now there are dairies that we've put in that weren't milking cows before, so I can't say what they did, but the existing dairies have all had a dramatic increase in milk production. They all say their general cow health and demeanor is better, and it has changed their lives as far as free time. The first guy that ordered them is over here, [Dairy Farmer 1]—you'll probably talk to him, maybe you already have—it was his [relative] that works with him—*[identifying information]*—after we put them in there, he made the comment, “I didn't know there was a first half to the Super Bowl!” He said, “I've seen every one of my kid's ball games this year, and I rarely got to see any of them at all [before having the robots], because it was always milking time.” And I don't recommend this, but earlier this year, Tom and Trevor, both of them had kids who were in a soccer match in St. George for some tournament, and they went.

Interviewer: Really? That's—not a thing!

Interviewee: Well, no! Not when you've got cows to milk twice a day in their case, and they had to be there to do that. It's changed their lives. They're out there chopping corn, a storm is coming: they don't stop to milk cows, they just keep chopping.

***Interviewer:** This is kind of a flip side question, but is there any technology that you've seen, either specifically for LELY or generally in the dairy industry—since you've been in dairy systems—is there anything that hasn't been very helpful, or hasn't panned out as being innovative?*

Interviewee: There were some barn designs, years ago, that I thought were duds, and they have been. [Inaudible] There's been good advances all along the way - different companies - there's some ideas that haven't been great, but they've been smaller ones. Yeah, I've seen some good ones and bad ones, but for the most part, there's been positive progress, but there have been some innovations that came and went that were duds, and there will be some more.

***Interviewer:** Okay. Do you recall, just off the top of your head, an example of some of those bad ideas, those "bad eggs?"*

Interviewee: There were some carousel parlors that were a bad idea. They still [inaudible] rotaries today [inaudible] changed the design considerably—they're a little better. I'm not a huge advocate of those, particularly the smaller ones because they're not efficient. There're still guys putting them in. A rotary parlor, to be efficient, has to be up to a certain size [inaudible]. I can go into details, but it's a manpower issue. You need just as many people around a small one as you a large one. So that tells you it's not very efficient if you're running a smaller rotary. There's the little thing—a few guys still go for it, I'm not one of them—called Stimopuls. It's a stimulating pulsator they put on there, thinking they can use that and then they wouldn't need to stimulate the cow before milking. Very few guys use that anymore, but there's still some who do. I didn't ever think that was the right approach. There's been a lot of little crazy machines that they've come out with. Some of them are terrible with high maintenance issues, some are just plain—a bad idea.

Interviewer: *So, I just have a couple questions about specifically about the program itself—*

Interviewee: The software?

Interviewer: *Yeah, the software. So, the first one is, coming from both the perspective of a LELY representative and also someone who works with farmers when they have a LELY robot, would you say that the format of the graphs and the reports are use friendly? Do you have any farmers coming to you, saying, “I don’t understand this,” or “How do I read this,” or different things like that?*

Interviewee: I think they are user friendly, but there is such a wealth of information, and it takes a while to learn to learn the computer programs, and they continue to get better and better at it—they soon become better than I am, because they use it every day and I don’t. But they seem to learn quite well. That is a big emphasis with LELY and [Dairy Company], is to help train them. LELY has its own little branch of the company called “Farm Management Support”, and their job is to help me and help dairymen better understand the software, [inaudible] utilize all those things to get the best results. And all their work is done after the sale, they’re not salesmen at all. One thing that—we’ve put dairy equipment in for years and there’s been a lot of computerization the past couple of years. We’ve sold a bunch of that that works with conventional dairies, and our challenge has always been getting the dairymen to actually use the computer. It’s there, they love the information, but pretty soon they’re totally ignoring it and it sits there, and it may go months without them using any of it. That’s great information, but they don’t use it. But with the robots, everybody uses it. They’re on it, they know their cows better than anything, we haven’t had any problem with the dairymen adapting to the computer, because this is their link to those cows. And because of those reports and the way they’re put together, they all use that computer. We don’t fight that. They adopt the computer and they become friends with it. Even one of the

dairymen we put it in for—didn't even have a smartphone or a computer before we put the robots in—he's good with the computers, he's good with the smartphone, and he's just been milking a little over a year. But he adopted all those things and has gotten very handy with them, because they do pick it up and use it. So, it must be friendly enough that they're adapting to it, and they're using it, because that hasn't been an issue, and it has been with other computer programs at conventional dairies. There will be a few that pick it up, but the majority didn't. You can put it in, but then pretty soon they won't be using it.

***Interviewer:** Yeah, what do you think the difference is? Why, aside from the fact that this is their link—but you could also argue that the old programs were also a link—so what do you think it is that has changed the attitude towards using the computer?*

Interviewee: Well, being the link is a little more important to them, with the robots, so they are a bigger need [inaudible], but also the way the program is put together, with such a wealth of information, is a lot more concise. For example, on this one right here, on LELY's T4C software—"Time for Cows"—there's a health report. Instead of studying all the different behavior of the cow, whether she's eating or drinking, whether she's walking and moving around, how much milk she's giving, or how much weight she's gained—the computer's doing all of that, you click on the health report, it's spills out a list of five cows that it thinks you maybe should pay attention to. So, it's done all of that sorting, and all of that figuring. Here's those cows, it gives a percentage chance that she's really sick and it gives you the reasons why. Now that's so much easier than trying to study reports, and seeing, "Which cow is this, which cow is that?" This software is based on management by exception. It builds a database on what's normal for each individual cow and if she varies off any of these different factors, of which there is over one hundred, she shows up on the list if she gets out of line somewhere. And the

dairyman then makes the decision, “Should I go do something about it?” But it is, it’s easier software, it’s more concise, it uses information not only to run the robots, but to put the report together to tell him just exactly what he needs to do. In some cases, it brings a cow up to him, and he just has to say, “Yes I want to treat her,” or “No I don’t.” But it’s right there on the screen for him, without him doing a lot of analyzing. It’s ready to go. So, I think that’s one of the big differences.

***Interviewer:** For sure, so instead of having this information given to you, but then you have to analyze it yourself, it does the [analysis] for you and then you can just make a decision based off of what the computer is saying.*

Interviewee: That’s right. Now you can analyze yourself to death if you want—the information is there—but there’s a lot of reports geared around—it makes the [analysis]—or here’s your list of actions, cows you need to do something with and what you need to do to them. Those lists come up, so it’s very easy.

***Interviewer:** So, kind of in addition to that then, I know that some farms around here have somatic cell devices, or they have rumination collars. Do you think that just kind of clouds the information more, are they able to still differentiate all those, or is it useful—does my question makes sense? What do those two devices add to the program that it doesn’t already contain?*

Interviewee: They’re great things. They do not cloud it. They actually bring those pictures more into focus. It’s just one more thing to add into that database on that cow to know what her rumination is, or what her activity is. And of course, the somatic cell counters are great, because a lot of times guys wouldn’t know which cows are really kind of getting sick, this tells them. There’s no question, they know right now. And in addition to that somatic cell counter, on each

of these robots, it checks the temperature of the milk coming out of each quarter of the cow every milking. It checks the butterfat, the protein, the lactose, and just the general condition of the milk—it analyzes those things. And the fluorine coming from each quarter. So, you know if a cow has done something and gotten injured—it's going to show up. They need to know that. All those things I think they just sharpen the focus on the reports that are here, because they do pull all of that information together and use it. The guys who have gotten a lot better results on their breeding because the activity monitor lets them know when a cow is in heat, so they spend a lot less time worrying about breeding their cows and keeping things up that way. Those things don't cloud up—they've been very good. And when they're not actually physically milking the cows—which a lot of guys don't [anymore], they hire it out—they're not out there touching that cow all the time. But right here, they know if that cow [has] got a bellyache almost before the cow does and that rumination [inaudible]. We had one of the dairymen, soon after he put the system in, he walked along their feed fence and saw pieces of wire in the feed, and that's not a good thing for cows to eat. That's usually going to result in some dead cows. They thought, "What in the world has happened?" And then they realized, "Oh, we just put this system in, we might want to check the rumination numbers." Here were six cows in trouble on rumination—it dropped right down, they just weren't eating, they weren't chewing their cud. They went—you might not be aware—but they went and put magnets in these cows, which grabs the wire and holds it, so they can either get rid of it or it hold it, so it doesn't perforate the inside of the cow. The cows dropped way down on the feed, they got sick, but then they came back out of it. They didn't lose any cows—the information was there. So, they do—they will realize they've got a cow getting sick for a lot of different reasons [inaudible] any other way. A lot of times they avoid a vet visit because they can see something coming on, and they can handle it before the

cow is really clinically ill. Those are just great marvelous things, and I think they're a real enhancement to the other information they're already gathering. It just brings things in more focus, makes it more finetuned.

***Interviewer:** So then in that sense, it's not that it's adding just more reports and more data, it's actually refining some of the health reports and the heat reports, and those sorts of different things.*

Interviewee: It does, because it puts all that package together. You're not looking at little pieces of information and wondering. You may have five different factors saying, "This is exactly what's going on," you're not wondering about it, and it may be combined right into that health report. Not to mention some of these things are—it'll sample milk, and say it's bad milk, it's mastitic milk, it doesn't meet the quality it should. It discards the milk, it doesn't even send it to the tank, it doesn't wait for the dairyman to come and do some of those things. If there's some blood in the milk or something like that, it doesn't wait for somebody else, it discards the milk, it doesn't go to the tank. That doesn't happen at a conventional dairy with hired hands who don't care. The milk just goes, and it goes, and there it is. We're actually getting some of the highest quality of milk in the world coming out of the robotic milkers because they're monitoring this milk by quarter, by cow, every milking [inaudible]. It's great for the milk supply too.

***Interviewer:** For sure. And then it also will separate out the colostrum from a first milking, right? I recall that from when I was over at Jeff Hall's dairy.*

Interviewee: Yep, it will.

Interviewer: *Okay, that's really cool. Okay, so there's just a couple more little things about the program then. So, I know, or at least I recall, that you can import reports from the LELY website or the LELY database. Is that a thing? I recall that.*

Interviewee: Well, they have a bunch of canned reports that come with it, and you can decide which one is your favorites, and at the same time you can modify those reports or create your own reports. And you can use the information in those reports, send it to the robots so it will sort cows based on the information there. So, if a particular thing is going on with the cow—whether it's a health reason or breeding—if this is going on, I want you to sort her out into a pen. So in this dairy right out here, if that's the case, there's a special pen for when the cows go through the robot—dairymen's not here, it's three in the morning, it will sort her off into a pen so when he comes out here at six or seven, he'll walk out here and see, “Oh, I got some cows out here.” He can pull up his phone and it will show the information right on his phone saying this is why she's in the pen, so he knows what he needs to do with her. And when she's in that pen, the way we've designed this barn, along with the others, they have access to water, they have a bed to lay on, they can still get to feed—they can even go back through the robot and get milked again and it will still keep her in the pen, until the computer or the dairyman clears her to go back to the herd. But that's right on his smartphone, and he can actually enter in the treatment for that cow as he's doing it, update the computer, and go right on with his life, so he's not out chasing all over for cows. A lot of the time the one he needs to work on are right there. That's a time saver.

Interviewer: *For sure, you're not having to go out and actually look or try and find the cow that [inaudible] because it's already been separated, and, well, hasn't been separated into the herd. Okay, so then, in conjunction with that, using your smartphone, do ever—I mean, farmers are using their smartphone, then, if they have one because it can do it right there, they can pull up*

the information as they're walking out among their cows—so there's also information on the program that you can "x-link", I believe, and that will actually pull up on the robot itself. Do you know of farmers really using that?

Interviewee: Oh, they do.

Interviewer: *They do use it on the robot itself then?*

Interviewee: There's a button right on the robot screen that says "T4C" which is [inaudible] software. They can punch that button and up comes the screen that's sitting here in the office.

Interviewer: *With the dials on it?*

Interviewee: Yup. And they can go to reports that are here and check them right at the robot. They can access this with their smartphone—not as convenient on the little one, you got to get used to that—but you've got the bigger screen on the robots, so you can access this and go to the reports there as well. So, it works just like a client-server type situation, it's all hardwired [inaudible], so they can access that more.

Interviewer: *So, kind of changing subject here again, when you are installing these robots, do you know about how long the farmer's deal with the cow and robot relationship, like how long it takes the cows to adjust to the robot. I've read some papers where—or articles—where at first it took about a year sometimes for the cow to really become adjusted to that robot. After that it's fine, right? But during that time, you know, have farmers asked you questions, or have they told you information about that time period or what happens?*

Interviewee: Well we work with the dairymen all the time, we don't leave here the day they start milking. We stay through startup, help that first—most of the week we have someone here all the

time, because there is a change process. But cows [are] very similar to people: they're not all the same. So, I tell dairymen: three days, three weeks, three months. Some of those cows, when we start next week, will be coming in [inaudible] robots on their own before the weekend comes; we'll start on Tuesday, and there will be some of these cows coming in on their own before the weekend comes. There are some that take a little longer, and there are some that a kind of boneheads. People are much the same way. As far as the year goes, they don't realize all the gains instantly. You're going to think I'm a partisan hack, but that's okay: I've been around other robots as well—and I know with the LELY robot—in all our installations, we've seen an increase in milk production within the first week. But it keeps going up. It's going to go up, and then it's still [inaudible] work on, as the dairymen fine tunes the feeding. Because the robot feeds based on their production, so that's kind of a balancing act between the nutritionists and the robots and the dairymen for that to happen—you're [inaudible], and at the same time, when the cows have to be trained from the conventional milker to this one, some of those cows aren't going to get the full bang for their buck out of being a robot cow until they've gone through another lactation. So, in that case, yeah, you're not going to see their full potential until all the cows have had a full lactation on the robot. But we do see great increase well before that, and this is what I'm going to say: that's not true, because not all robots are created equal. The software is not the same, the way they treat the cow is not the same, and the results aren't either. So [inaudible], those are some of the little research things I wondered about when we were researching robots, so I've seen that. But either way, [for] cows, some adapt quicker than others, but generally within three months they'll usually have it figured out.

***Interviewer:** So maybe part of the reason why these reports were saying it takes about a year for the farm to actually be up to its capacity is because of that lactation. Maybe it's not necessarily the cows are "boneheads" for a year, it could be more just the cycle of the cow itself.*

Interviewee: Well, there's one other thing, and you probably don't even want to know about this, but you're going to have to hear it [anyway]. [There're] a couple different philosophies about robotic milking. One of them is "free cow traffic" and the other one is "forced cow traffic", the difference being: the robot is there in free cow traffic—it's there, the gate is open, cows can come and go whenever they want. [In] forced cow traffic, there's a series of one-way gates, and if the cow wants to get to the feed fence or back to her bed, the only way to get there is to be forced through the robot, and she figures out that has to happen. [There're] reasons that things do that. On the LELY robot, it makes the entrance real easy and have totally gone into the free traffic, and they promote that. They used to be forced cow traffic, but they saw a great improvement when they went to free cow traffic. And I'm a big believer of free cow traffic, because the cows break quicker, they train to the robots quicker, and we get better results, and we get them faster. Whereas the forced cow traffic—the cows are forced there so they're standing long times waiting to go through, and they're being forced to do things—none of us like to be forced—so the results aren't quite as good. And to back that up, it was the Journal of Dairy Science did a pretty extensive three-year study on that and found that guided cow traffic, or forced cow traffic, versus free cow traffic—I think it was 2.4 lbs. of milk per cow per day on average. And they average quite a few dairies doing that. So, I think it's a real telling thing. So, those are some differences in philosophy on how you manage those cows. And what LELY's done to work that free cow traffic, that box that the cow stands in has to be a safe, comfortable place for the cows, and has to be easy to get in and out. So, what they've done they've called,

“iFlow”: a cow can walk straight in, she can walk straight out the other end, she doesn’t have to walk in and turn and come back out, which they call “K Flow”. And when she’s in there, she’s got room to move back and forth and side to side a little—not tons of room, but she’s not...

Interviewer: *She’s not cramped.*

Interviewee: She’s not cramped in a tight little box. Most of the other robots out there, they call it “indexing the cow”. What it amounts to is once she’s in there, it squeezes down on her, so she can’t move around as much. Makes it easier for the robot to attach. The problem with that is cows don’t like that—neither do you. So those cows don’t come in there very well like free cow traffic deal, so they have to go to the forced cow traffic because the cows don’t want to be there that much. Now they’ll go, but it’s not as enjoyable. What they’ve found is real important for good free cow traffic [is] that box has to be comfortable for the cows. That’s a real important thing. And the feed has to be good, because the feed is what get them in there.

Interviewer: *That was something that was actually referenced in one of the papers I read, was that free cow traffic was better than forced cow traffic, because if it’s in the forced cow traffic, I mean, you can think about it with feed cows, how, you know, the chute has to be put at the right angle, otherwise shadows scare them and they can see you and they get freaked out.*

Interviewee: Well I mean, yeah, go read Temple Grandin’s stuff. You know, she’s done so much work on some of those things. Either way: cow comfort is so very important. They don’t like being indexed or put in a squeeze chute—I don’t either.

Interviewer: *So, there’s really just a couple of questions here left. So based on your experience—you’ve kind of already talked about how LELY has the farm management trainers who come in, but do you think it would be beneficial for the farmers to have a manual or even*

like a guidebook so if a farm management trainer isn't around or they have a quick question, they can reference that faster?

Interviewee: Here's their dashboard. See this thing right here, it says, "Your Guide"?

Interviewer: *That's new?*

Interviewee: No—I mean, this is the newer version software, but this has been on there for several versions.

Interviewer: *It has?*

Interviewee: You can click "Your Guide" and start putting in a question and it will start answering. So that is an online thing, it's right there, clicks on, and you can start researching your questions. If you're not sure, right there it is. And that "Your Guide" has been there ever since we've started installing robots.

Interviewer: *Okay, last question—*

Interviewee: It's not as friendly as I'd like. It wants the question to be posed about right. But you can search through different things, or even put the question in, and you're almost better off to do the searching, because if you don't put the question like it likes, you may not get as good of a result as you want either. I wish that was a little more improved. But it is there, and it is a pretty good resource you can use to get some ideas how to do it. As well, they have user forums on there too—which are not by LELY—but a lot of people join those because they'll get a question, put it out there to the world, and their buddies will say, "Oh this is what I do." You know how those things work. But, yeah, this is part of the software, that "Your Guide", and it does that—takes you right out on the internet.

***Interviewer:** So, then that leads right into my last question: is there any aspect of the robotic milker that you wish was different or changed? Is there anything unfriendly or—you said “Your Guide” could be a little more friendly.*

Interviewee: Oh, I think there’s always—I kind of nag them. I think in our technical training on the robots—they are improving that, and it’s a pretty rigorous course. I mean we have to fly our guys to—I think most of our training has been in Pella, Iowa, where they make these robots. I’ve had to go to that training too, but you fly back there, and you have to sit in class for a week, and on Friday morning you take a pretty hairy test that takes several hours. If you don’t get a passing score, they say, “Great, come back in a couple of months and try again.” And then of course you have to recertify every two years, and you can start out as a Level 1, and you’re not even qualified to take the test for Level 2 until you’ve been servicing robots for a year. So, you keep moving up through the different progressions [inaudible]. They’ve been improving that training as they’re going along—hats off to them they require that because that’s very important. It’s probably just my own arrogance, I just think they can do a little better job training. In the way they present it, I think there can be some improvements that way. And, you know, there’s a lot of stuff, it’s a very dynamic situation, there’s a lot of changes, there’s regular software updates, and it’s difficult to keep up with all of them, but it is such a high tech deal, there’s a lot of information and you have to stay pretty focused to stay up with it. As they simplify that—and they are simplifying it, it is improving—it’s just like anything else, they’re getting better at it. See these are the A4 robots, and we’ve started some of our training on the new A5, which they are now producing. But we haven’t installed any A5 robots yet, but they’ve simplified a bunch of things with the A5 robot: easier to diagnose, easier to repair and less repairs, less maintenance on them. They are improving. We’ve dealt with a lot of dairy equipment companies in the past

however long that is—longer than I want to talk about—I haven't ever had a company that's as dynamic as LELY about moving forward and making changes. They don't make a model and sit on it forever, and they're always trying to improve. They dedicate 6% of their gross receipts to research and development. I've never been around a company that put that much into R&D. So, there's always a lot of new stuff going on, new products that we don't get to hear about that they're working on until they're ready to go. Like the new A5 robot. [Inaudible] that's why I went to Holland in the spring. When they unveiled that, they'd had those robots in operation, I think in sixteen different dairies around the world, for a year and a half. So, they'd milk a couple million milkings before we even got to hear about it. Yeah, that's pretty good dedication to me. All the people involved with that had to sign non-disclosure agreements with penalties. It wasn't just some "please don't tell", they had to sign up for that. Yeah, the dairymen, the milk haulers, as well as the LELY guys, they all had to sign these. Two of those test dairies were here in North America, and I've been to both of them, and I asked them, "How did you keep this quiet?" But either way, yeah, it was all very serious, but that's some real dedication as a company. LELY, I'm really impressed with them as an organization and how they do things. Too often, in my years being a dairy equipment guy, I realized I'm the R&D department. They make it, ship it out, and they expect me to make it work, and then tell them what the problems are. That's an expensive operation for us. One of the reasons, when we were talking about robots early on, I said, "No, until they've got thousands out there, and they've simplified it and the price has gone down, I don't want to be involved," because I didn't want to be the R&D department for a robot.

Interviewer: So, they've eliminated that liability with you and really, you're just, you're the servicemen, which is what you really should be.

Interviewee: We're the service guys, I'm not the R&D department. That doesn't mean we don't still have things that make you want to pull your hair out. It's equipment, it's not perfect. It's really good, it's a great company, there's a lot of support to it, so that's important.

Interviewer: *Cool. Well that's all the question I have for you. Thank you so much for letting me take your time.*

Interviewee: Okay, thank you.

Dairy Company Owner Interview

Interviewer: Principle Investigator, Jessica Christensen

Interviewee: Dairy Farmer 1, private owner of dairy farm in [Location of Dairy], northern UT

Interview Setting: Dairy Farmer 1's dairy in [Location of Dairy], UT

Affiliation with interviewee: Has previously allowed research on his robots

(Start of Interview) – *the start of the interview did not begin with a question, but rather as a conversation about how the night before the interview he had an issue with the robots. Interview begins at that point.*

Interviewee: They're kind of hit and miss that way, though. You go multiple days in a row—even multiple weeks—without calling and not working well. And then all of a sudden, I'll have a night like last night when—it was cold last night, and almost all of the issues I had were related to the cold, and yet, it's the first—we were five [degrees] below [zero], and typically we don't have a lot of problems until we're ten [degrees] below [zero], but, I just didn't turn up the heat up enough last night before I left. Once you get the area cold, it just takes a long time for it to warm back up—like, it's not as simple as me going out the first time and turning the thermostat up. But anyway, [I've] learned—in fact, I should have thrown my blanket away—when I go to the barn in the middle of the night I don't walk back upstairs, because I know if I do, number one, I'm not going to get back to sleep very fast, and number two, I'll wake up my wife. So, I just stay down here usually. Yeah, the robots called—I don't know, I was out there from, probably 2:00 [a.m.] until 6:00 [a.m.], so it was a lousy night.

Interviewer: *Yeah, I was up at 5:30 this morning going for a run, and it was ten degrees up where I live, but that was a cold ten degrees with the canyon wind coming down. (Personal story – identifying information)*

Interviewee: When I was up at Utah State, they were studying BST out at the Caine Dairy, and the year that I graduated from Utah State was the year that BST was approved. [Agriculture Company 1] offered me a job in a heartbeat—I interviewed, and they offered me a job. I went to work with them—I worked for [Agriculture Company 1]—well I worked for [inaudible] which is [inaudible] [Agriculture Company 1] ended up selling to [Agriculture Company 2]. Anyway, I worked for them for seventeen years. Towards the end of it, my parents—we lived in a couple different homes, but we never left [Location of Dairy]. I always told [Agriculture Company 1] [inaudible], “I’m just not moving.” And they made me some pretty nice offers, but anyway, so I said eventually I’m going to quit and leave you guys and buy the dairy from my parents. My dad needed both of his knees replaced one year, [personal story] so we bought this, and I built that house over there for my father, and so we’ve lived here since, and it’s been fun. (Personal story – identifying information)

Interviewee: It’s a great system that they have, to tell me the robot’s out of order. In the middle of the day, it’ll call us for a lot of things, but at the nighttime, we only have it call us if it’s shut the robot down. So, we don’t get the annoying phone calls in the middle of the night.

Interviewer: *That’s something interesting, actually, that I read in one of my papers, was that differences between a traditional milking parlor and a robotic milking parlor is that—traditional, you close the gate, you close the door, you’re done for the night, you go to bed, but you have to get up early in the morning, whereas with the robots, it’s, “Oh, I’m done for the*

night!” or so you think, until you get a call at two o’clock in the morning, and then you’re up all night.

Interviewee: You’re exactly right. The biggest downside that I’ve learned is we’re never done milking. Every single minute of the day, there could be something go wrong, and in reality, it’s just like I said: before, I had four full-time workers and for the most part, they could fix most things. Yeah, I might have to go fix some things. But now, I truly believe [Dairy Employee 1] can fix most things, but the problem is I only have two workers, so if I have him on call in the middle of the night, then I have to be out there early in the morning to feed the calves and do everything. I’ve actually learned that, I’d just as soon be on call every night, so I tell [Dairy Employee 1], “Unless I’m gone—if the robots call you, don’t worry, I’m home, I’ll take care of them. You just make sure you’re down here at 6:30, because if I’ve been out there from 2:00 to 6:00, I’m not coming out there at 6:30, because that’s what time we typically start. It’s worked out pretty good, but that is the downside—the biggest downside—to robotic milking, is we truly just are never done milking the cows.

Interviewer: *That’s something—in correlation with that though—something I was reading about: you have more free time, but at the same time you have more responsibility with that, because you don’t have to always be out there, or you don’t have to fetch the cows necessarily, or all these different things. But with that, there’s the flipside that, you’re always on call, you always have to make sure that the robot’s working, or you’re always looking at the reports from it to see how the cows are doing, because you’re not out there with the cows all the time. It’s actually funny, there’s an article I was reading done in Norway, and the farmers were like, “Yeah, we love it! But ‘this’ really does not work well.” Because they really don’t have more free time in a way.*

Interviewee: I think that's the biggest reason why my wife— (*Personal story – identifying information*)— my wife signed off on it, on letting us get the robots, was the free time. She really wanted me to be able to have more free time. And in all reality, like—we're 3.5, almost 3.8 years into it—it just hasn't panned out, and the problem is, before—so, when you look at the vast majority of dairies that have gone to robotic milking, they have been almost 100% family farms, most people only have two robots. Like, it's 1.8 robots per average farm, so that tells you there's a lot of one and two robot farms. And when you look at those, they were—they were at the dairy doing all the milking themselves, so they didn't have any hired labor. In a dairy our size that we were milking our cows three times a day, we had a lot of hired labor—I think I had more free time before because of the hired labor I had. It's true, all those things that you say, and all the things LELY tells me from the fact that—I have free time, I don't have to physically be at the barn, but I don't know that I ever feel like I can go further away than the house, type thing. Yeah, I'll take my son and drop him off at basketball practice and go to his basketball games and things like that, as long as they're close, if they're in Preston or Logan or in between, but for me to take—he plays in—he's thirteen or fourteen years old—when he plays in leagues like in Farmington—gol, I really just don't know that I want to be two plus hours away if the robots call because even though [Dairy Employee 1] can fix most things, he can't fix everything. The price of milk has truly sucked ever since we put in the robots. We're going on four years of pretty low milk prices. I think if I were more profitable, I would be more willing to call the [Local Dairy Company] and not think that I needed to fix it myself. And yet, the other side of that—so, by no means do I have any problems with [Local Dairy Company], they're totally fine; that's the company who sells my robots—but, there have been numerous times that I called [Local Dairy Company], and I'm like, "I have this alarm, or this problem," and the owner of [Local Dairy

Company], he just says, “Well, we’ve never had that one. Let us know how you fix it,” type thing. And initially that ticked me off, and I thought, “Holy balls, [inaudible] I just spent a million bucks with you guys, come and fix it.” But the fact is, when you look at the robots around here, I have four, and nobody else has any more than two, until now. Now [Local Dairy Farmer 1] has six that are in—and I guess [Local Dairy Farmer 2]’s have four, but they were two years later, type thing. So, I had two years of going with double the number of robots of anybody else. And so, I felt like—my wife said it best, that we’ve been the guinea pigs for the company and for the system, and we really have. And it’s come without any compensation or things like that. So that’s kind of been a little bit of a—I don’t know, a pain in the butt I guess, you know, more than anything, is having to call the company and having them really have no idea. I feel like I pay a lot of labor for them to train. I’ll call them out and they’ll be out here for six hours to find something that—and when they leave, they’re like, “Oh, next time we’ll know to look here first.” And I’m thinking, “You know, it took you fifteen minutes to fix this problem. I out to have a thirty-minute repair bill instead of a six-hour repair bill.” So, anyway. I guess it is what it is, but that’s the frustrating side of it.

Interviewer: Yeah, for sure. That was, again, in the same article that I was reading, it was kind of interesting how they were comparing the early adopters and those who have come a little bit later. And the early adopters, they’re great because they’re more familiar with the system, whereas these later adopters come in and they’re always coming to those earlier adopters and saying, “Hey, how do I fix this?” or “What’s this problem going on?” But, of course, the article points out that these earlier adopters have a lot of issues that they’ve been dealing with, with these. And it even pointed out—it was comparing DeLaval versus LELY, and it was saying LELY,

hands down, one of the best options out there, but there are still a lot of problems with it, with early adopters trying to figure it out.

Interviewee: Yeah, I agree, I feel like I know my robots better than the people that are putting them in right now will ever know them because—LELY/[Local Dairy Company], I don't know who's footing the bill, but they've hired me to go and help run every start up of every dairy around here since I put mine in. When I go do that, like when I was at [Local Dairy Farmer 1]'s helping him get started two weeks ago—I guess part of me sits here and thinks, "I just don't know that he'll ever take all the different parts of the robots apart like I have, because when [Local Dairy Company] come out, like when he calls and says he has a problem, [Local Dairy Company] is going to come out, and they're like, "Oh, we've had this problem at Jeff's. We'll fix it right here." Whereas, when I call them, we take six or seven parts out of the robot, rebuild them and fix them, try all kinds of things, trying to figure out what the problem is. And so, I think that's a great point the article brings out, is the early adopters, we definitely know the robots inside and out a lot better than even a lot of the technicians know it.

Interviewer: *For sure. So funny enough, we've actually kind of answered like a whole section of my questions, just talking, which is great, it's kind of how I wanted to run these interviews. I didn't want it to be a question and answer, I wanted it to be a discussion. I wanted it to be organic. Okay, so you already told me a little bit about your dairy operation, as in like how you got started here: you grew up doing it, you bought the farm from your parents.*

Interviewee: Yeah, so I'm sixth generation. My dad and two of his brothers—my dad has four brothers and one sister—and they owned the piece of ground just right to the south of me. The house to the south of me (*Personal story – identifying information*) was my Grandpa Hall's house. And they had a dairy there, and when I was seven years old—we lived in the closest

house to the Idaho border, and when I was, I think four years old, we moved down to this house, and my dad's parents actually owned all the ground around it except for right across the street. And his dad said, "Come back down to the dairy and help us, because you're the only one that really wants it." So, he came down, but, working with family, he was only here for two years before—he was over there, and he told my grandpa, "We're doing all the work—me and my kids—and we're only getting one fourth of everything." So, he said, "We need to include a partner." So anyway, they drew up a partnership, and at the last minute, one of his brothers threw a fit, so my dad said we're building this dairy. So, when I was seven years old, we started building this dairy. We started milking it when I was eight years old, and within two years my uncles had sold out, and they just—and then my cousin, actually, when he got home from an LDS mission, he started milking over there again for a little bit, but it just didn't last very long for him. He was trying to milk there and in [Utah City 1], and he ended up moving to [Utah City 2]— [Utah City 3] actually, and he works for [Company]. But, anyway, so, that's kind of how we got going here. I know on mornings like this one, when it's colder than crap in [Location of Dairy], I sometimes wonder why the crap Grandpa Hall stopped right in this spot in [Location of Dairy] and why he didn't move up to the [inaudible] hills or someplace a little more sandy and flat. But yeah, our roots have been in [Location of Dairy] forever. *(Personal story – identifying information)* That's a little history of the dairy. When I bought the farm from my parents, I already owned 49.9% and they owned 50.1%, and then we actually bought their 50.1% in, it was either '08 or '09, one of those two years, the last time the dairy cycle was as bad as it was. *(Personal story – identifying information)*

Interviewer: So, then you've been working specifically here—full-time, it's all your dairy—since '08 or '09, was it, right?

Interviewee: So even though I bought the dairy from my parents in '08, I still worked it—well, the last three years I worked for [Agriculture Company 2], I worked just part time. (*Personal story – identifying information*) I planned on walking away from that job. My wife's plan for me was always to walk away in 2008, and then when the price of milk dropped so bad in '08 and '09, I think I ended up leaving [Agriculture Company 1]—I must have left them in 2012. So yeah, in '08, I guess I can't say I was full time on the dairy, but I had—the whole time I worked for [Agriculture Company 1], I just had great workers. I am fluent in Spanish (*Personal story – identifying information*). [Dairy Employee 2] was kind of almost the manager when I was gone, but it just worked out great, like I didn't have any problem communicating which—it's not too big of a deal today, but, ten [to] fifteen years ago it seemed like a lot of the Hispanic culture and those people didn't speak the English that they do today. But anyway, when I left in 2012 was when I actually came back full time. And even though I bought the dairy from my parents, my father still continued to help mix feed and things like that.

Interviewer: So, especially having the history that you do, working for dairy farms and also working here on your own, and working with other dairies in the valley, what would you say are some of the technologies that have really just impacted the dairy industry in a positive way, but also in a negative way?

Interviewee: Well, I don't know how far back you want to go. It's kind of one of my things: every time somebody, a neighboring dairyman, wants to blame the latest technology for the low price of milk, I always throw back, and I learned this in one of my college classes, that ever since we got the technology of on-farm refrigeration—like once we got the ability to cool milk on farms, we had the ability to milk a lot of cows. Before that, you really didn't. And so, I guess when we go back, that's been the best technology, even though that was a long time ago, we

don't really consider that. When I think of the recent technologies, of course: BST. I loved BST. I think it was a great management tool. I think that if the consumer would have been better educated, that we wouldn't have ever had the labeling issues that we now have. But, in hindsight, I think that BST was one of the biggest game changers for milk, because ever since BST came on, now we've had the disparaging labeling of milk, and I think that once we started labeling milk "pesticide free" and "antibiotic free"—so all milk is antibiotic free, all milk is pesticide free—but we started having, I would even say, some unethical advertising, because I don't think that people ought to be able to disparage their milk by stating a false claim that all milk has. So, I think BST was—the technology itself was great. If we're truly going to feed the world, and we need our smaller carbon footprint, we need to be more efficient—boy, there's no better way to do it than BST. I truly don't think there's any negative effects on cows from BST. I think there are negative effects of cows from people's management styles. But, looking back, BST changed how milk is marketed in an unreal way. When I look at the other most recent technology: sexed semen. I think sexed semen has had a lot bigger impact than anybody ever thought it would. When sexed semen came out, you had all the big economists and all the big college professors that were saying, you know, "In order to make this pay for itself, breed your top third of your cows to sexed semen, your middle third to conventional, and your bottom third to beef." Well, I don't know anybody who did that. People started breeding 100% of their cows—especially Jerseys and heifers—to sexed semen, and all of a sudden we're sitting at 9.3 million cows in America, and we're sitting on, you know, heifers that are 0.8% of the milking herd average—and all-time highs were at 0.62% and 0.63%, and we need the national herd at 9.1 million, and I don't know that we'll ever get back to 9.1 million because of all the heifers that are available. I think that sexed semen has just really changed the game, especially for large dairies. Small

dairies—the data all indicates that smaller dairies have lower cull rates, they have excess heifers to sell. Their market was always the big dairies. Small dairymen could always recoup a little bit of their loss of efficiencies in being able to market some of their excess animals to large dairies. And the last two [to] three years, that just hasn't happened. I think that's one of the biggest reasons you so see so many small dairies going out. But anyway, I think sexed semen has just been—I think, and here again: I think it is an amazing technology. It has made it so that when we breed our virgin heifers to sexed semen and they calve, they just don't have any problems calving, we don't have to help them. The incident of difficulty with a heifer calf versus a bull calf is, I don't know exactly what it is, but 2.8% to 3.5% difference. Boy, that's a huge amount, especially in a heifer. So, I don't know, I just think it has done so much for the industry that way. But the negative side I think is a lot bigger right now than the positives of sexed semen. I could probably talk about technology for three hours, different things, but I'll leave it at those two or three, unless you have something specific, you'd ask about.

Interviewer: No, not really. I mean, there were things that have increased production, things that have increased cost efficiency, things that have increased cow health—but then again, things that have done the opposite of that. Especially with economics, we kind of talked about those things; labeling, and, well, the effects on small farms, which is kind of a big deal.

Interviewee: Let's face it, I think—like, some of the technology in even how we feed cows—in fact, locking mangers in and of itself is sometimes a technology that—it is so much easier to do vet check days, and things like that, with something as simple as a locking manger. Something as simple as a TMR wagon. I'm not sure that people really thought it was going to increase milk production as much as it did, and at the same time, increase the health of the cows. When you stop and figure that we're trying to keep the pH in the cow's rumen between 5.9 and 6.4, that

was tough to do before a TMR wagon, because you fed them their concentrates in the barn, or top dressed, and outside you fed them the forage, and the pH in the stomach was all over the place, and now, gol, I haven't pulled pH samples from stomachs in a long time, but from looking at cows, I bet we hardly ever dip below 6.0 and we probably aren't ever over 6.3 unless we have an anomaly come in. So, there's just a ton of technologies that—like I said, as little as locking mangers that have just great things for cow health.

***Interviewer:** That's really cool, I hadn't really thought about just the simple things like that.*

That's really cool. Okay, so, now I have some specific questions about the robots. So first off, you talked about how [your wife] signed off on getting a robot because she wanted you to have more free time, but why were you interested in getting the robot?

Interviewee: Cow health. I still have the paper upstairs that I wrote down on—the year before I put in the robots, I went with every major company, in this very basement, and every single one of those companies came in and gave me their sales pitch on robots. Some of the companies said, “We won't even sell you a robot today, we don't have one that works, we're going to pull our M1 off the market next month because it's not working.” The DeLaval people said, “Gol, Jeff, you're just five years too early, we're not sure robots are really going to take off.” And they said, “We can't give you—we couldn't sell you one if we wanted to right now, because, number one, your dealer would have to commit to two million dollars' worth of inventory parts.” I know that [Local Dairy Company] has over one million dollars in inventory they have to keep now. I don't think they would have sold me robots, had they not had multiple dairies that were looking at them. So, when I had that, I have to admit, I was totally looking for cow health. We had a pretty good—we had a lot of production. Here again, as we visited earlier, a lot of the people [who] went to robots climbed a lot on milk because they were only two time a day milking, they didn't

have any outside labor. Our milk production has plummeted since we put in the robots, it really has. I'm very discouraged with our milk production since we've put in robots. But our cow health is through the roof. We breed cows, they get pregnant; every morning we look at the activity monitors and we see the cows that are in heat, we breed them, they get pregnant. We look at the cows that have decreased their activity, we go check on them. We look at the activity monitors of our close-up cows, and the ones that have—of course I can pull this up on my own computer in here, and look and see, if I have two cows that are in my close-up pen calving, and they're both high on activity, odds are I have a calf out there, or I'm getting a calf. So, it has truly made managing the dairy almost a computer-driven event. I look at the computer for milk quality, for activity, for sick cows—it's been a lot of things, but I was interested in robots, I guess, for the cow health side of things. Even though we milked our cows three times a day, our holding pen wasn't big enough. So, we were not very efficient. Two years prior to putting in robots, we remodeled our parlor and made it a double eleven parallel rapid exit. The problem is, we'd raise the gate for the rapid exit: we have eleven cows now that are done, but the wall is to close, so they don't have room to move, and so they still have to file out—a single file lane, sixty-two feet before they get to the other end. Yeah, we could get the milk out of them really fast, but it didn't really increase our efficiency. So, we had as inefficient a parlor as anybody I had seen. To this day, I have numerous people ask me all the time, "How did you make the robots pay for themselves?" I have one dairyman that from day one, a friend, he said, "You'll never make it pay." He said, "I've penciled it out, it'll never pay." And I said, "It'll never pay for you, because your parlor is so efficient. You're milking in a double twenty parlor that has wide walls—you lift it up, all twenty cows are gone—it's down and you're milking again." I think the number one reason—the number one economic driven reason—that people can pay for robots is

if your parlor is so inefficient that you're having to over pay for labor, that it'll work. The other problem with an inefficient parlor is holding pens suck. You take all these fifteen-hundred-pound animals—cows get to be in the habit that every time, well, not every time, but most the time they see a human, it's to get them up and herd them into this tight-knit holding pen. So, they go in here, they can't sweat, and you have all these fifteen-hundred-pound animals in there together. So now you have created a great big heat pack there. You have a crowd gate so you're keeping them right there next to each other, it's the wettest place on the dairy so now all their feet are in the water—you're keeping them in there. So, you get them up in the parlor, you milk them, you get them back out, and now since they're all up and they've been moving and been away from feed and water for—I realize you're only supposed to keep cows in a holding pen for forty-five minutes, but few people do that in old parlors. So, it was an hour and ten minutes, three times a day. Now they all go get locked up along the manger, all at the same time to eat. It's easy managing because you can clean the corrals when the cows are out, you can bed the stalls, but it just wasn't very cool for the cows. And in the summer, it's even worse, because now you have the radiant heat on them, they're hot, and we could cool them in the parlor—yeah, we can blow air across them—but in all reality, then they go out to the feed bunk and they're standing right next to each other again. So, our cow health, it sucked to be honest with you. I just was not happy with our incidence of lameness. We just didn't seem like we could keep weight on cows. Now we were getting a lot of milk out of cows, too, but our cow health really sucked before we put in the robots. So, my driving force to putting in the robots was cow health, and it has definitely paid off in that regard. We just hardly have—like we used to have our hoof trimmer, he came every three months and he'd come one day, and a lot of days come back the next day. And now, we have him scheduled every six months and when he comes, we have a rough time

finding him enough cows to do in a day. Like I say, our reproduction, it has just become, it's become fun to be breed cows again. I was almost a reproduction physiology major [*inaudible*], I love the genetic side of cows and that side of it. In fact, I have my [ABS] book right there that just came. I just love being able to breed to high end bulls, and before, I had a rough time spending that on semen because I knew that my conception rate sucked and some of those things, and my cow turnover was just higher than I wanted it. So, cow health was the reason that I was interested—and it has really helped from a cow health perspective.

Interviewer: *So, in what ways has it increased the cow health then?*

Interviewee: Cows are able to lay down so much more. They get up when they want to. They don't have to stand in the holding pen, they're not standing away from water, they're not all eating at the same time. So, our incidence of lameness has gone to just dang near nothing. And here again they're not standing on their feet unless they're drinking or eating, they really are laying down so much more. The other thing is the cows—I would daresay, that my herd of cows is as calm as any herd of cows you'll find in the nation, maybe the world. And they weren't that way before the robots. Now they were very calm herd before, we've always been very strict on—we love cows. But when we walk through the pen, the cows come and follow us, and lick us, because they know we're not herding them. We might be looking for four, five, maybe six cows out of the hundred and eighty that are out there to go put through the robots. And so, 99% of the cows know, "Hey, you're just going to walk past me, you might slap me on the hip to see if I'll stand up to see how full my udder is." And a lot of times I'll slap them, and they just turn and look at me like, "What the crap do you want, buddy?" So, they're just so much more comfortable in their own atmosphere on their own schedule that they're not standing up in the holding pen on their own. The other thing: we lock our cows in pretty much once a month. We have our vet

come once a month. Sometimes we have him come more often to look at one or two cows, but to do herd health it's now once a month. I don't know that we could have ever done that before. Number one, we just had so many fresh cow problems, so many herd health problems. But now, we get cows pregnant so easy, we're thinking of going every other month. Our fresh cows—we didn't have a ton of fresh metabolic problems before, but now—when you have robots, you can set it to milk that cow up to six times a day. Every time she comes through and lets her milk down—causes any oxytocin effect and pituitary gland effect, and it's causing the uterus to contract—so that she's pushing any of that junk from freshening out, and she's cleaning up. A lot of the data out there [inaudible] did it, shows that increased milking frequency the first sixty days of lactation doesn't necessarily give you any more milk—like I think it's 1.5 to 2.0 pounds a day, it's minimal, it's not worth the cost—the benefit is in the reproductive tract and getting it all cleaned out. And so, here again, a cow health issue. So, specifically, just so many less freshening issues—and not necessarily freshening, but post-partum, like the first thirty days—metritis, retained placentas—just hardly exists. The second thing is, they're just not on their feet, we just don't have lame cows. Our cows' body condition score—if you're familiar with that, it's just about what kind of condition they're in—I'm sure we're a half a point, three quarters of a point, maybe a full point higher. We just find it easier to keep weight on cows. Now, also having said this, we're down on milk also, and maybe that's part of that function also. But anyway, our cow health has sky rocketed, with those areas being the biggest three.

Interviewer: Yeah, again in one of those articles I was reading, it said if you were milking two times a day [there is an] incredible increase in milk going to the robots, but if you're milking three times a day, it's negligible, or even a little bit less. But, in your case, you actually are

making more money because you're not spending it on vet visits or on different things like that, right? On that flipside?

Interviewee: So, yeah, and of course, the price of milk plays into it so much and the price of milk has been low, so I don't know that we're making any more money because of that, but when we stop and figure out our cost of production, our cost of production with the robots is less than what it was prior to putting in the robots. I'm an economics major from Utah State. When I say that it doesn't make any sense because 99.9% of the time, the more output I can get, the better that's going to be for my cost of production. And so, in order for my cost of production to be lower with these robots than it was prior when I was getting more milk—we've saved so many costs that were just wasted before. So yeah, that does pay off.

Interviewer: *Okay, so then, a little bit more on the robot program or software. Would you say that the presentation of the graphs and reports is user friendly, or is there a learning curve, and—does that kind of make sense?*

Interviewee: Oh yeah, so there's definitely a learning curve. The first year, maybe a year plus, I kept my old program—DHI-Plus. I, having worked for [Agriculture Company 2] and [Agriculture Company 1], I can pull PCDART records, I can pull DairyComp records, I can pull any of them. There's a LELY Robot User's Facebook page that I'm on, and this question came up on that: comparing the T4C—which is LELY's software program—versus some of the others. I replied on there, I said, "If you will delve into it and be determined to learn it, within two years you can be every bit as happy with it as you are with any other program out there." I truly believe that. Is it as user friendly as DairyComp? No. Is it as user friendly as DHI-Plus and PCDART? It's more user friendly. I maintain there's two big ones: DairyComp and DHI-Plus. PCDART in the Midwest and East is a big one, and the South. But when I look at the LELY

T4C, I think it is compatible with any of those. I truly believe it is every bit as user friendly as any of them. You've just got to take the time to get to know it. The first year, I never would have said that because I kept DHI-Plus because that's what I knew. The fact is, I'm forty-five plus years old. At forty-five plus years old I don't learn that stuff as I did when I was twenty-two and I learned DHI-Plus. And I think that's the position that most of the people who are putting in robots—they're not twenty-two years old. I think as we get the kids who were raised on robots and on T4C, they're going to be able to do every report and everything they want with the T4C software and program as they ever could have with the other ones. [*Inaudible*] opinion, but yeah.

Interviewer: *No, that's consistent with other interviews that I've done and with the papers that I've read. There seems to be a learning curve and some farmers are very [discouraged], but once you get that time, you can learn the information like that, and it's presented to you so easily. Okay, [that just kind of covers everything]. Okay, so then how is the usability of the robot itself? Like, how long did it take your cows to adjust to the robot? Do you use the XLink feature there on the screen of the robot? Yeah, those two questions.*

Interviewee: I hardly use the XLink feature. My son and daughter, and nephew and niece, that all work for me—and also, I have a neighbor kid who is mentally challenged that comes down—they use the XLink—they'll make a list of the fetch cows that haven't been—are you familiar with what fetch cows are?

Interviewer: *Yes.*

Interviewee: Okay. So, they'll make a list of the fetch cows, and they'll go put them through, and they'll use the XLink factor screen, link to make sure those cows were milked successfully, because if not they'll go grab them again. I don't know that I've used the XLink ten times in four

years. But, yeah, so, kind of hit and miss with that. The cows—first calf heifers that didn't know any other way, they are acclimated in all reality between five to seven days. We push them through two times a day, sometimes three, but for the most part only twice a day for the first three [to] four days. Ninety-five plus percent of them, by day four, are going through on their own. The mature cows, of course, now after they calve in, we put them down there and a lot of times they get to the robot before we're in the flat barn to milk them. So, they're acclimated perfect. The initial start-up—I think it's a big function of if you use the training mode. I used the training mode, and yet, the training mode is you hook it all up and allow them—the cows—to go through and eat, and the robot arm comes up alongside of them and moves and makes noise but doesn't go underneath. And LELY recommended that I use it, but when I asked them to set it up, they said, "Oh, I don't know that I know how to, nobody's ever done it." And most of the time it's—people just spent hundreds of thousands of dollars on robots, the minute they're ready they want to push cows through. But we decided to go ahead and use it, so our cows kind of got acclimated, that they could come in and eat, and yet, it was still tough. We probably had 70% of the cows acclimated within ten days. We probably had another 20% of them that took maybe even up to two months longer. The last 10% they almost never got acclimated. To this day, we have four cows out on our fetch list—we have these four—they seldom go through on their own more than once a day. And so, we push them through morning and night, and have done for almost four years. And I realize some people would say, "Oh, I'd sell them." Great, if they were your cow, you can do what the crap you want with them. They're my cow, I'm not selling them; I like the cows, they're good cows. We're already out there in the morning pushing some cows through, we're already out there in the afternoon pushing some cows through. We put these four on the list and we push them through every single day. I'd say every day, let's face it, sometimes

on Sunday we don't, sometimes if we're busy we don't. But for the most part, they're getting pushed through two times every day because they never acclimated. We've never had that problem with a first calf heifer that didn't know any other way. But these cows, they were already on their second, third lactation when we got the robots, and they have just never learned that they can go through the barn or through the robot more—as frequently as—and I shouldn't have said they haven't learned because every once in a while they will have surprised me and they'll have come through in the middle of the night or the middle of the day. But, by and large, they didn't, and so how long it takes the cows to adapt, I think that's a function of how willing the owner is to replace some of those types of cows. I know when I was up at [Dairy Farmer 1] starting last week, [Dairy Employee 3], his herdsman and dairy person, he said, "You know, how long is it going to take me?" And I told him, "That's your call, if you're going to sell them, you're going to be really happy in two months, you'll truly have 100% of the cows go through if you're willing to sell anything that doesn't go through." But I think that's, I don't know, that's just kind of a tough question to answer, because I think every herd is different depending on what kind of herd they were, if they were a tie-stall herd, or a free stall, or if they were an enclosed barn type herd. I think those cows all move and do things different.

***Interviewer:** Okay. So, if LELY engineers were to ask for you input on future generations of the robot, what would you tell them?*

Interviewee: I would tell them that they've got to consolidate all of the sewer water and milk and that kind of stuff. So, the first four ccs of every quarter of every cow gets flushed down the drain. Every time it rinses it get flushed down the drain. But we spray water too many places inside the robot. So, I think that's a simple fix for them, and yet they haven't done anything about it. I think we're constantly having bolts fall out that we have to rethread with Loctite and

put back in. I don't know if they need to start putting lock nuts on them or things like that, but as the robots get older, I fear that that's going to become a problem more and more. I continually am wanting to have better scanning or better—just the initial milking when the robot's scanning for the teats, I just want—I want it to be better, and I realize that's part of almost every one of their updates in their software, but I guess I think that's something they can continually work on and improve, is that part of it. Other than that, I'd love to improve the feed system just a little to make it—it works out fine until you have to unplug it, and then it seems like it's very cumbersome to take the feed sensor off, to take the auger out and shut everything down so that you're safe and I don't get a finger cut off in the auger. I'd love that to be—have a clean out port on it, have something to be so that we could get that done a little easier. Other than that, I don't know that I'd—I have a lot of people that say, “We've got to change the milk pump system.” Our milk pumps haven't been any problem. I know I have numerous people say, “We've got to change the Festo valves.” I get people that say—I'm into it almost four years and I've changed two of my four robot's Festo valves and I changed them both in the last three months. So, I went three plus years without having to change Festo valves. Number one, they're not that costly to begin with—yeah, they are if you're having to change them every three months like some people—but I am just super happy with how the robots have performed to be honest with you. I don't use the LELY inflations. The LELY robot is common enough, and the parts are common enough that I use GEA inflation in it because I don't like the LELY inflation. My dealer knows that I'm not using the LELY inflation, and so I guess if I was pro-LELY or something, I'd say, “Ah, LELY engineers, get a better inflation.” But, I guess, I don't care if they get a better inflation or not, in all reality. They probably have 0.1% of the inflations in the world, and GEA probably has 30%. I feel like I'm following the technology by using a company that's invested in

inflations. Let LELY worry about the robot part of it. I guess the only other part of it is the airlines that are on the robot arm that come up to the brushes, I'd love them to be inside the arm, like if they could make the arm hollow, even if it needs to be a little bigger to put some of those lines inside. They just get mashed too often, and things like that. The only other real issue that I have is with the brush motor, we have a ton of problems with the brush motors. And most of the time it's the cable that—and here again, it's the same thing—it's getting mashed right at the very end. So, a little bit more durable or going inside, just some of those things to protect it. But by and large, we have just—I don't have a lot of complaints about the LELY robot.

***Interviewer:** Okay, so we've talked about most of these questions. So, then the last question—I mean we're almost done here—based on your experience with robotic milkers, do you think that like a hard copy or just a user manual would be beneficial versus “Your Guide”? So I know that there's the “Your Guide” on the software itself that you can go in and put questions in, but I did talk to [Dairy Company Owner] about that specifically a while ago, and he's like, “Oh, it's fine, you can put the questions in,” but he did say that the problem with putting questions in is you have to phrase it a certain way for it to pull up a relevant answer. So, do you think that the “Your Guide” is sufficient along with the Facebook groups and discussion boards are sufficient, or do you think that it would be beneficial to have a manual of sorts?*

Interviewee: I wouldn't use the manual. I've never used the “Your Guide.” I guess—I don't consider myself mechanically inclined at all either, to be honest with you, but when I—[Dairy Company Owner] has been in shock, he's told me numerous times, “You're our robot user that, you know everything about T4C,” and he told me that after I was eight months into it. He calls me with issues, they all call me—which number one, I'm fine, and I truly believe that a lot of that has to do with my background working with [Agriculture Company 1] and BST—I've been

on everyone's computer and can pull reports and things—I just don't have any real problems with it I guess, I wouldn't use the manual, I don't use that part of it. I love the Facebook page. There's a glitch in [the robot's] system that anytime your computer shuts down, when you start back up T4C, if you have a certain type of computer, it won't let you in and it give you a run time error. And that happened to me the first time ever on a Sunday morning and like five o'clock in the morning. Well, it happened during the night. I don't know why it is—most of the computer companies have their software updates on the weekends. The problem is, it updates, then it doesn't start T4C again, and so then I get a time out communication error. Anyway, so I go out and try to start T4C, it gives me this run time error. I get on Facebook, I pose this question, within twenty minutes I have an answer back from a LELY tech service guy. And he—they monitor those things because that was a technical question—he gives me the answer, tells me how to fix it. I actually have a sheet out in my barn, that has, I think, four different line things on it, and the first one is, "How to fix the run time error." The bottom one is something as simple, "If negative, then tighten," because one of the things that I have to do often is calibrate the cup offsets, to make sure that they—when it says it's straight up and down that it is. And I always forget, when it runs on the screen, if it's positive do I tighten, or is it negative. So, I just have—just on this sheet of paper—something as simple as that, but those four things help me a ton. But the LELY's Facebook—the LELY robot user's Facebook page has helped me more than any other thing, believe it or not. And I know—I don't know if [Dairy Company Owner] is on it, he's never answered anything or asked anything on it, but—I know he kind of laughs and mocks at me a little bit for using it, but the LELY tech people are on there all the time, and most of the answers I get are right from a LELY tech person on it. *(Personal story – identifying information)* I don't look at [Facebook] that often, but I know that if I need to go to that LELY thing, I can go

there. A lot of times I can type in a question there, and just back through the history I can find somebody else already asked that same question or something similar; I can find my answer from a previous post. So, my kids would think it's funny that's I'm saying this, but I truly believe that the social media has almost become my best source for fixing some of the problems.

Interviewer: *Yeah, I mean in that Norway paper that I read, one of the biggest impacts in this particular area—I mean, tons of farmers were adopting robots and they're having really good success with it, and they went and tried to figure out what it was, and one of the biggest things was that it was just that social influence. These farmers would get together on a weekend day and I think it was have tea and coffee with each other, or something, and they would discuss problems they were having, and they'd say, "Oh, I tried this for that," or "Oh, I tried this for that." And it's been incredibly helpful for them to be successful, is just that social influence.*

Interviewee: I totally agree with it.

Interviewer: *So then, in those cases, do you think that some of these problems or issues—I just, I know that a lot of dairy employees are Hispanic and speak Spanish, and so maybe it's not as big of an issue like you said, it would have been fifteen years ago, but do you think that having some those guidelines or steps or even a "Your Guide" in Spanish—do you think that would be helpful, or even useful?*

Interviewee: On my barn computer, I actually have the Spanish version of the "Your Guide" and the English version. If I ever need to try to train [Dairy Employee 1] or tell him exactly what to do, then I can find it in the English version, go to the same page of the Spanish, and just have him read it, or at least get a few words so I know what part I'm talking about. In all reality, I haven't used it in the last two years, I'll bet. Like, it was one of those things that at first, I

thought, “I’m going to need this, it’s going to be important,” but—it’s almost like any owner’s manual. Have you read the owner’s manual of your car?

Interviewer: *No.*

Interviewee: No. And in all reality, I don’t know anybody who read the owner’s manual of anything except an engineer. Like, they’re the only people who are really going to sit down and read the owner’s manual. And so, yes, I have that ability to do it at my dairy, I thought I’d really use it, and I probably did a couple times at first, but I just don’t anymore. If I’m gone and [Dairy Employee 1] has to come down, he just brings one of his three kids, because they all speak perfect English, they were all three born in the United States. [Dairy Employee 1] has been here for, I don’t know how many years, thirty plus years now. So, yeah, I don’t know that that would be a big deal in this day and age.

Interviewer: *Do you think that maybe on another dairy farm, like some of the dairy farms here in Southern Utah where they have, you know, twelve thousand cows or, huge amounts of cows, and a lot of hired help, do you think that something like maybe in that situation? I know that you wouldn’t have a lot of perspective on that because yours is you know, less than two hundred cows, but do you think that in that case it might be helpful? I’m just curious on your thoughts.*

Interviewee: No, I actually think that’s just going to be one of the job requirements, that you’re going to be speaking English, or understanding English, because it’s not just the robots, it’s having to communicate that. I guess I think if it was a full-time Spanish guy running it—so number one, you can get everything in Spanish so that it was because there are robots in Spain and Mexico and those places, so you could do that, but I guess I’m sitting down here thinking, “If [Utah Dairy Farmer 1] or [Utah Dairy Farmer 2] down there decide that they’re going to put

in robots then in all reality they're either going to have to decide to go English or Spanish. And if they decide to go English, they have plenty of workers, or they're going to have to find workers. If they don't, even though that worker can fix that robot, he's not going to be able to go back and report to management or the owners or anybody else. I actually—like I said, I've worked with the biggest dairies in the nation—I just don't see that that's going to be an issue. But the other side of that is, I think that robots are a long ways away from going into great big dairies. I think big dairies are going to automate, and I think you'll see robotic teat sprayers and robotic prep, but I don't know that you're going to be able to afford a full-scale, large robotic dairy and be profitable. Now, if you've won the lottery or you've made all your money in chickens in California like [inaudible] or somebody, yeah, and you want to put them in for show, more power to you. But I don't think they're going to pencil out on huge scales with where they are now. But even if they do, yeah, I just don't think that the language barrier is going to be a big deal.

Interviewer: Makes sense. Okay, we actually talked about this last question, "What aspects of the robotic milker would you like to be different or changed?" We kind of already talked about it.

Interviewee: So, the biggest one I hear from everyone is, "Oh, we need a manual attach button." Don't know if you've heard that. That's the biggest thing on Facebook, "LELY needs to be able to say that you're going to attach it manually this time." And my point is, I don't even want it. In all reality, yeah it might take a few more minutes, but the robot eventually has to learn, and it just as well learn on the first time as any other time. Yeah, I just don't know that I'd change a whole bunch. The things I would change are very minor from what most people talk about.

Interviewer: Okay. Those are all the questions I have for you. Thank you so much.



EXTENSION INITIATIVES

Facilitate Understanding of
Automatic Milking Systems



RESEARCH BASED INITIATIVE

In the fall of 2018, research was conducted to determine what challenges dairy farmers face in implementing automatic milking systems into production systems.

Results from this research indicate that farmers face common challenges in four different areas:

1. Unfamiliar with computerized technology and smartphones; immense amount of data collected and presented by the robot
2. Farmers don't spend as much time observing the cows - possible disconnect from the cows behind the numbers
3. Somatic cell devices and rumination collars add more variables and data into the pool
4. Training cows to adjust to being milked by a robotic milker

TRAINING CLASSES & SEMINARS

Beginning in 2020, semiannual trainings should be held in each county. These trainings will offer dairy farmers the opportunity to:

1. Learn how computerized systems work
2. Ask questions in a low-risk environment

Trainings will be open to all dairy farmers, whether they have interest in AMS, have installed AMS, or want to learn more about computerized systems.

To prepare for these trainings, Extension agents are suggested to research AMS software. They will then be better equipped to train farmers how to sift through data to make informed management decision, based off AMS software specifically.

PURPOSE

Introduction of AMS, or robotic milkers, is relatively new to the western U.S., and requires challenging adjustments and new management systems.

The goal of implementing these trainings is to assist in dairy farmers' transition to automated technology, in addition to providing education to all dairy farmers on computerized technologies.

„To succeed with AMS, farmers need to act proactively in following up the individual cows, and to get familiar with the herd management system.“

Optimizing Robotic Milk

A Qualitative Research Approach to Understanding Challenges that may Inhibit Optimal Usage of Automatic Milking Systems in Northern Utah

Jessica Felts
Utah State University

Dr. Allen Young
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Introduction

Automatic Milking Systems (AMS) – or robotic milkers – have been on the market for over twenty years. However, AMS introduction is relatively new to the Western U.S., and requires challenging adjustments and new management systems.

Hypothesized problems include:

- Introduction of computerized technology
- Amount of data received from robots
- Adjusting to managing cows and AMS
- Developed apathy due to robot's capabilities

In short, the research question: Do dairy farmers face challenges integrating AMS into their production systems?

Challenges

1. Unfamiliar with computerized technology and smartphones; immense amount of data collected and presented by the robot
2. Farmers don't spend as much time observing the cows – possible disconnect from the cows behind the numbers
3. Somatic cell devices and rumination collars add more variables and data in the pool
4. Training cows to adjust to being milked by a robot milker

Solutions

1. In addition to support from AMS companies and distributors, Extension can hold training workshops on computerized technology
2. The robots collect over 100 variables on each cow – the reports are the link to the cows with exact information
3. This provides more information for farmers and Extension agents on cow health and reproduction status
4. Extension agents can suggest alterations to cow traffic (free vs. forced) and dispensed feed

Figure 1 – The LELY Astronaut



View from the backside— "screen side"—of the LELY Astronaut, an AMS, showing the arm going underneath the cow, preparing to attach the cups post cleaning.

Figure 2 – The Software



Key Performance Indicators (KPI) from Time for Cows (T4C), the computer software for the LELY Astronaut.

Results

Although AMS companies and local dairy technology and systems companies may have farmer support systems in place that assist farmers, it is critical that Extension agents are aware of and understand those systems. In addition, Extension agents should have their own strategies in place to assist farmers with AMS, or to understand the management and operations of dairies with AMS.

Conclusion

Based on preliminary research, Automatic Milking Systems have increased production, efficiency, and cow health; however, dairy farmers still face challenges optimizing their systems, and Extension agents lack adequate information or training regarding AMS to adequately assist dairy farmers. A publication from this project will help Extension agents understand issues and opportunities with AMS technology from a user perspective, and, thus, effectively assist farmers.

Biography

Jessica graduated from USU in 2018 with a bachelor's in Animal and Dairy Science and a minor in Asian Studies. Shortly after graduating from Logan High School, Jessica served a religious mission to Phnom Penh, Cambodia. Spending time in the rural rice paddies rekindled her love for agriculture and rural lifestyles, thus inspiring her to study agricultural systems, specifically dairy automatic milking systems.

After graduation, she intends to pursue a master's at USU in Public Health Nutrition and plans to pursue a career as a Nutritional Epidemiologist. When she's not doing research, she enjoys reading a good book, going on adventures with her family, riding horses, and playing with her dogs, Tiberius, Bay, and Bo.

Capstone Reflection

Introduction

Not only writing an Honors Capstone but engaging as an Honors Student through my academic career as proved to be both an incredibly rewarding experience as well as a refiner's fire. I can, without doubt, say that I have left undergraduate years a much better, more developed person than when I entered these halls of learning.

When I came to USU in the fall of 2014, I will admit I was prideful that I was an Honors student; I was one of a select few on campus, perhaps even a "privileged" few—how wrong I was. Being an Honors student has nothing to do with privilege. To become an Honors student, one must strive for excellence in the face of adversity and self-doubt. There has been more than one occasion throughout the last four years, particularly these last few months, where I wondered if I was capable of being an Honors student and completing the required tasks.

There is a quote from a man who survived the hallowed experience of the Martin Handcart Company, a piece of Latter-Day Saint history. He said, "The price we paid to become acquainted with God was a privilege to pay, and I am thankful that I was privileged to come in the Martin Handcart Company.'" (Relief Society Magazine, Jan. 1948, p. 8.) While I would never submit that my academic career has been anything even remotely similar to the harrowing experience of these pioneers, I do say that in my own way, my last four years has been a refiner's fire where I have come to know my God. I am grateful for the blessing and experience of becoming an Honors student. For me, this journey has taught me that I can indeed do hard things, that I have that capacity within me; I've "got the makings of greatness in [me]" (Musker, John, and Ron Clements. *Treasure Planet*. Walt Disney Studios, 2002).

Writing a Capstone

The process of researching and writing my capstone was, to be honest, long and tedious at many times. I started researching dairy robotics over two years ago. Interesting that the local dairy farm I started my research at also happens to be one of the farms I ended my research at. Anyway, there were times when, either due to other priorities or a simple lack of motivation, I went months without doing any research or work on my capstone. However, these occasional breaks actually ended up benefiting my work. When I wrote my capstone proposal in the spring of 2017, I struggled finding six sources that I could reference for use in my capstone. However, when I started looking again a month ago, my search found well over one thousand different papers, four hundred of which I looked through.

I think that one of the most profound lessons I learned from the process of writing my honors capstone was, as this saying—and tongue twister—embodies: work will work when wishy washy wishing won't. My capstone experience taught me that anything in worthwhile in this life is going to take hard work, and it's not something that you can do overnight either.

A Valued Experience

If it wasn't for my capstone project, I would not have met the wonderful professors who have become lifelong mentors and friends. I also wouldn't have had the opportunity to meet a variety of dairy farmers and producers in the dairy industry, from all over the country and even internationally. These interactions have positively changed my view of dairy farmers and the dairy industry.